Claims

1. A method for downscaling a digital coloured matrix image by selected ratios M_2/M_1 and N_2/N_1, in which the matrix image includes N_1 rows, each row including M_1 pixels, so that the values of the pixels form the matrix and the pixels of different colours form the selected format, and in which scaling is used to form an output matrix, of a size $M_2 \times N_2$, the pixels corresponding to sub-groups of the original matrix, in such a way that $M_2<=M_1$ and $N_2<=N_1$, and from the values Input(j,i) of which pixels (i,j) the value Output(l,k) of each output pixel (k,l) of the output matrix is calculated, <u>characterized</u> in that the weighted sum of the values of the same-colour pixels (i,j) of the matrix image in the area of each output pixel (k,l) is formed, the weighting coefficient being the dimension share of the pixel (i,j) in the area of the output pixel (k,l) and each weighted sum is corrected by a scaling factor ($f \times M_2/M_1 \times N_2/N_1$).

2. A method according to Claim 1, <u>characterized</u> in that the scaling is carried out in one dimension (x) at a time, by calculating the intermediate sums Outx(l) of this dimension in the memory location (Data[0], Data[1]) by forming the weighted sum of the intensities of the pixels of this dimension, the weighting coefficients being the proportion of each source pixel (i,j) in this dimension's output pixels (k,l) and by transferring the sum finally to the line memory (Buffer[0], Buffer[1]), to each elementary unit (l) of which the intermediate sums Outx(l) of the output pixel (k,l) of the corresponding column (k) are calculated.

3. A method according to Claim 2, <u>characterized</u> in that the calculation is performed by using alternating pairs of memory locations (Data[0], Data[1]) and alternating pairs of line memory (Buffer[0], Buffer[1]), in such a way that
- in the case of a part pixel (i.j), the initial part intensity of the following output pixel (k+1,l) is also always calculated to a second memory location, in which the summed intensity of the subsequent index (k+1) is in turn collected, and
- in the case of a part row, the intensity value of each pixel (i,j) is divided between both memory locations, in proportion to how the pixel covers the output pixel (k, l) and the following output pixel (k, l+1) in the corresponding dimension and is summed over the length of the output pixel and each first sum is stored in the next row buffer in turn and

the second sum is stored in the second row buffer ((l+1)mod2), in which the sums of the following output row (l+1) are begun to be collected.

4. A method according to any of Claims 1 – 3, characterized in that the output image is moved relative to the input image, in such a way that part of the information of the edge pixels of the input image is left unused and correspondingly, at the opposite edge, additional information is extrapolated to the input pixels.

5. An apparatus for downscaling a digital coloured matrix image by selected ratios (M_2/M_1 and N_2/N_1), which the apparatus includes an application memory for storing and processing the scaled matrix image, a central processing unit (CPU), a program memory area and a program stored into for performing the processing, and in which the matrix image includes N_1 rows, each row including M_1 pixels, so that the values of the pixels form the matrix and the pixels of different colours form the format, and in which the pixels of the output matrix, of a size $M_2 \times N_2$, formed by the scaling, correspond to subgroups of the original matrix, from the values of which pixels the mean value of each pixel of the output matrix is calculated by calculating the sum of the values and dividing it by the scaling factor ($M_2/M_1 \times N_2/N_1$), characterized in that the apparatus is arranged to process the input pixels (k.l) individually, in such a way that the said sum of the values is formed weighted from the values of the same-colour matrix-image pixels (i,j) in the area of each output pixel (k,l), the weighting coefficient being the dimension proportion of the pixel (i,j) in the area of the output pixel (k,l).

6. An apparatus according to Claim 5, characterized in that the memory area includes four memory locations (Data[0/1][0/1]) and two line memories (Buffer[0], Buffer[1]) and that the apparatus is arranged to perform scaling in one dimension (x) at a time, by calculating the intermediate sums Outx(l) of this dimension into a memory location (Data[0], Data[1]) by forming the weighted sum of the intensities of the pixels of this dimension, the weighting factors being the proportion of each source pixel (i,j) in the output pixels (k,l) of this dimension and to transfer the sum finally to the line memory (Buffer[0], Buffer[1]), the intermediate sums Outx corresponding to one calculated output pixel row (l) being arranged in each elementary unit (k).

7. An apparatus according to Claim 6, characterized in that it includes an alternating pair of memory locations (Data[0], Data[1]) and an alternating pair of line memories (Buffer[0], Buffer[1]), to which address means are linked, which are arranged using the least significant bit of the functioning binary-form index (k, l), in such a way that
- in the case of a part pixel (i,j), the initial part intensity of the following output pixel (k+1,l) is also always calculated into a second memory location, in which the sum intensity of the following index (k+1) is in turn collected, and
- in the case of a part row, the intensity value of each pixel (i,j) is divided between both memory locations, in proportion to how the pixel covers the output pixel (k, l) and the following output pixel (k, l+1) in the corresponding dimension, and the part values are summed and stored over the length of the output pixel in the line memories (Buffer[0], Buffer[1]).

8. An apparatus according to any of Claim 5 - 7, characterized in that the apparatus is integrated in connection with the camera sensor of the camera.

9. An apparatus according to Claim 8 and including a host system, characterized in that scaling in one dimension is integrated in connection with the camera sensor of the camera and the scaling in the other dimension with the host system.

10. An apparatus according to Claim 6 or 7, characterized in that the apparatus includes a scaler component, in which there are separate processors (CPU) for scaling in each dimension.

11. An apparatus according to any of Claims 5 - 10, characterized in that the apparatus includes memory for the scaling operations of at least two output-image lines for each colour component.

12. An apparatus according to any of Claims 5 - 11, characterized in that the memory required in scaling is implemented in the processor (CPU).

13. An apparatus according to any of Claims 5 - 12, characterized in that the apparatus is arranged in a mobile terminal.

14. A method for downscaling a digital matrix image, by means of software, by selected ratios M_2/M_1 and N_2/N_1, in a digital device, in which there is a scaling component including at least an input unit for bringing the input rows to the scaling component, a processor and memory for processing the data, and an output part from forwarding the processed data, and in which the matrix image includes N_1 rows, each row including M_1 pixels, so that the values of the pixels form the matrix and the pixels of different colours form the selected format, and in which the pixels of the output matrix, of a size $M_2 \times N_2$, formed by scaling, correspond to the sub-groups of the original matrix, in such way that $M_2<M_1$ and $N_2<N_1$, and from the values Input (j,i) of which pixels (i,j) the value Output(l,k) is calculated for each output pixel (k,l) of the output matrix, characterized in that

- each input row is brought in turn, and each pixel is taken individually to the processor for processing,
- the weighting coefficient for each pixel is calculated in the area of the output pixel, the weighting coefficient depicting the part of the surface area of the pixel in the output pixel,
- the values of the pixels of the input row are summed in the area of each output pixel (k,l) according to a predefined sequence, in such a way that a weighted sum is formed of the values of the same-colour matrix-image pixels (i,j) in the area of each output pixel (k,l), and each weighted sum is corrected by a scaling factor ($M_2/M_1 \times N_2/N_1$),
- the corrected sum is transferred out through the output part.

15. A method according to Claim 14, characterized in that the memory includes at least two pairs of memory locations (Data[0], Data[1]) for summing the intensities and two line memories (Buffer[0], Buffer[1], and in which

- the relationship of the input line j to the output line l is defined and
- the intermediate sums Outx(i,l) in the selected dimension (x) are calculated to the memory location Data[k mod 2] that is now in turn and the final part of the part pixel to the second memory location (Data[(k+1)mod2]) and the sum is finally transferred to the line memory (Buffer[0], Buffer[1]), to each elementary unit (l) of which the intermediate sums Outx(i,l) of the output pixel (k,l) of the corresponding column (l) are calculated.

16. A method according to Claim 15, characterized in that

- the memory locations (Data[0], Data[1]) of the pair of memory locations and the line memories (Buffer[0], Buffer[1]) of the pair of line memories are addressed with the aid of an alternating function,
- in the case of a part pixel (i,j) the initial part intensity of the following output pixel (k+1,l) is always also calculated and is stored in the second memory location, in which the sum intensity of the index (k+1) following in turn is collected, and
- in the case of a part row, the intensity value of each pixel (i,j) is divided and stored in both memory locations in proportion to how the pixel and the following pixel (k,l+1) cover the output pixel (k, l) in the corresponding dimension (y), and are summed over the length of the output pixel and the first sum of each is stored in the line memory now in turn and the second sum in the second line memory ((l+1)mod2), in which the sums of the following output row (l+1) are begun to be collected.

1. A method for downscaling a digital coloured matrix image by selected ratios M_2/M_1 and N_2/N_1, in which the matrix image includes N_1 rows, each row including M_1 pixels, so that the values of the pixels form the matrix and the pixels of different colours form the selected format, and in which scaling is used to form an output matrix, of a size $M_2 \times N_2$, the pixels corresponding to sub-groups of the original matrix, in such a way that $M_2<=M_1$ and $N_2<=N_1$, and from the values Input(j,i) of which pixels (i,j) the value Output(l,k) of each output pixel (k,l) of the output matrix is calculated, characterized in that the coloured matrix image is read only once and the weighted sums of the values of the same-colour pixels (i,j) of the matrix image in the area of each output pixel (k,l) is formed parallel in line memories (Buffer[0], Buffer[1]) arranged for each colour, the weighting coefficient being the dimension share of the pixel (i,j) in the area of the output pixel (k,l) and each weighted sum is corrected by a scaling factor ($f \times M_2/M_1 \times N_2/N_1$).

2. A method according to Claim 1, characterized in that the scaling is carried out in one dimension (x) at a time, by calculating the intermediate sums Outx(l) of this dimension in the memory location (Data[0], Data[1]) by forming the weighted sum of the intensities of the pixels of this dimension, the weighting coefficients being the proportion of each source pixel (i,j) in this dimension's output pixels (k,l) and by transferring the sum finally to the line memory (Buffer[0], Buffer[1]), to each elementary unit (l) of which the intermediate sums Outx(l) of the output pixel (k,l) of the corresponding column (k) are calculated.

3. A method according to Claim 2, characterized in that the calculation is performed by using alternating pairs of memory locations (Data[0], Data[1]) and alternating pairs of line memory (Buffer[0], Buffer[1]), in such a way that

- in the case of a part pixel (i.j), the initial part intensity of the following output pixel (k+1,l) is also always calculated to a second memory location, in which the summed intensity of the subsequent index (k+1) is in turn collected, and
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- the values of the pixels of the input row are summed in the area of each output pixel (k,l) according to a predefined sequence, in such a way that a weighted sum is formed parallel in line memories (Buffer[0], Buffer[1]) arranged for each colour and each sum is formed of the values of the same-colour matrix-image pixels (i,j) in the area of each output pixel (k,l), and each weighted sum is corrected by a scaling factor ($M_2/M_1 \times N_2/N_1$),
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- the relationship of the input line j to the output line l is defined and
- the intermediate sums Outx(i,l) in the selected dimension (x) are calculated to the memory location Data[k mod 2] that is now in turn and the final part of the part pixel to the second memory location (Data[(k+1)mod2]) and the sum is finally transferred to the line memory (Buffer[0], Buffer[1]), to each elementary unit (l) of

which the intermediate sums Outx(i,l) of the output pixel (k,l) of the corresponding column (l) are calculated.

16. A method according to Claim 15, characterized in that
- the memory locations (Data[0], Data[1]) of the pair of memory locations and the line memories (Buffer[0], Buffer[1]) of the pair of line memories are addressed with the aid of an alternating function,
- in the case of a part pixel (i,j) the initial part intensity of the following output pixel (k+1,l) is always also calculated and is stored in the second memory location, in which the sum intensity of the index (k+1) following in turn is collected, and
- in the case of a part row, the intensity value of each pixel (i,j) is divided and stored in both memory locations in proportion to how the pixel and the following pixel (k,l+1) cover the output pixel (k, l) in the corresponding dimension (y), and are summed over the length of the output pixel and the first sum of each is stored in the line memory now in turn and the second sum in the second line memory ((l+1)mod2), in which the sums of the following output row (l+1) are begun to be collected.